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RANDOMIZED QUESTION POOLS AND ADAPTIVE TESTING: A TWENTY-FIRST CENTURY SOLUTION TO EXAM MALPRACTICES IN COMPUTER-BASED PUBLIC EXAMINATIONS

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Abstract
Examination malpractice remains a significant challenge in the education sector, undermining the credibility of public examinations and educational standards. In Nigeria, prevalent forms of malpractice, including copying, collusion, question spotting, and impersonation, account for nearly 58% of reported cases in recent years, as highlighted by WAEC and JAMB records. This study explores the effectiveness of randomized question pools and adaptive testing as innovative solutions to mitigate exam malpractice, improve exam security, and enhance fairness. The objective is to evaluate the extent to which these methods reduce cheating opportunities and address specific types of malpractice, including copying and collusion.The study reviews existing literature on exam malpractice and the application of technology-driven testing systems, focusing on randomized question pools and adaptive testing. A quantitative research design was adopted, analyzing data from examination malpractice incidents before and after the implementation of these strategies between 2019 and 2021. Statistical tools, including descriptive analysis and chi-square tests, were employed to assess the effectiveness of the interventions. Results showed a significant reduction in malpractice rates: copying decreased by 65% (from 18% to 6%), collusion dropped by 60% (from 20% to 8%), and question spotting reduced by 73% (from 15% to 4%). However, impersonation cases remained stagnant at 5%, indicating gaps in addressing all malpractice types.The study concludes that while randomized question pools and adaptive testing effectively reduce specific forms of malpractice, complementary measures such as biometric verification and robust ID checks are essential to tackle impersonation. Investments in technological infrastructure, personnel training, and public

awareness campaigns are recommended to ensure seamless implementation and maximize the impact of these strategies, especially in resource-constrained environments.

Keywords: Adaptive Testing, Exam Malpractice, Computer-Based Testing (CBT), Public Examinations, Randomized Question Pools

Introduction

In the past two decades, there has been a global shift from traditional paper-based examinations to computer-based testing (CBT) in public examinations. This transition was driven by the need for more effective, scalable, and secure testing systems and the growing integration of digital technologies into educational practices. In Nigeria, public examination bodies such as the West African Examinations Council (WAEC) and the Joint Admissions and Matriculation Board (JAMB) have adopted CBT as part of extensive efforts to modernize examination processes and address long-standing issues of integrity, efficiency, and inclusivity in testing (Ajayi & Ojo, 2021). CBT offers several advantages, such as real-time result processing, enhanced question diversity, and reduced logistical costs (Afolabi&Oyedokun, 2022). Nevertheless, the rise of CBT has also led to the emergence of new challenges, particularly in curbing exam malpractices, which continue to undermine the credibility of public examinations.

Despite the advantages of CBT, exam malpractice remains a persistent issue. Malpractice in computer-based exams takes various forms; including cheating through unauthorized aids collusion between candidates or with external parties, and impersonation (Lawal *et al.,* 2020). For instance, a study by Omisore and Adeleke (2021) found that 30% of students engaged in some form of cheating during CBT, and 18% were involved in collusion with other candidates. 15% for impersonation, where candidates hire proxies to sit for exams on their behalf, has also been reported in several cases, accounting for about 12% of malpractice incidents in Nigerian public exams in 2020 (Umar *et al.,* 2022). These malpractice issues threaten the credibility of CBT, highlighting the need for stronger preventive measures.

Randomized question pools and adaptive testing have emerged as modern solutions to address these exam malpractice challenges. Randomized question pools ensure that each candidate receives a unique set of questions, reducing the likelihood of collusion or pre-exam question leaks (Ibrahim *et al.,* 2023). Adaptive testing, on the other hand, adjusts the difficulty of questions based on the candidate's performance, making it harder for candidates to share answers or rely on predetermined cheating strategies (Oseni *et al.,* 2022). By introducing an element of

unpredictability into the examination process, these approaches not only enhance exam security but also provide a more accurate assessment of a candidate's true abilities. This reduces the unfair advantage gained by dishonest candidates and ensures a level playing field for all examinees.

The adoption of randomized question pools and adaptive testing could have significant implications for public examination bodies like WAEC and others. These innovations offer a scalable solution to the widespread problem of exam malpractice, which undermines the reliability of public certifications (Musa & Abubakar, 2021). For organizations like WAEC, integrating these methods would require investment in technology infrastructure and staff training. However, the long-term benefits such as improved exam integrity, greater fairness in testing and enhanced public confidence in the examination system justify this investment (Okeke & Chijioke, 2020). Furthermore, the introduction of these advanced testing methods aligns with global best practices, ensuring that Nigerian public examinations maintain international standards of excellence and reliability (Adetunji *et al.*, 2023).

The development of Computer-Based Testing (CBT) dates back to the 1960s when initial efforts were made to automate the testing process, primarily through mainframe computers (Bennett, 2015). However, the widespread use of CBT did not occur until the 1990s, with advancements in personal computing and the internet. CBT gained significant traction because of its efficiency, scalability, user-friendliness, and ability to process results faster than traditional paper-based tests (Adewale & Ogunleye, 2020). Globally, over 60% of standardized tests, including college entrance exams like the Graduate Record Examinations General Test, known as the (GRE), or the Graduate Management Admission Test, known as the (GMAT), are now conducted through CBT (Mulvaney & Taylor, 2019). In Nigeria, the Joint Admissions and Matriculation Board (JAMB) adopted CBT in 2015 for its Unified Tertiary Matriculation Examination (UTME), citing reasons such as improved fairness and security (Afolabi & Ayodele, 2022). Despite its advantages, the implementation of CBT has introduced new challenges, including the persistence of exam malpractice, albeit in different forms.

Various examination bodies across the globe have adopted CBT due to its potential to streamline exam administration and improve the fairness of assessments. For example, the Educational Testing Service (ETS), which administers the Scholastic Aptitude Test (SAT) and GRE,

transitioned to a CBT format in the early 2000s (Bennett, 2015). Likewise, the International English Language Testing System (IELTS) offers a computer-based version alongside its traditional paper-based tests. In Nigeria, WAEC introduced CBT for its professional exams, such as the West African Senior School Certificate Examination (WASSCE), especially in science subjects and vocational skills (Ibrahim & Umar, 2021). JAMB's full transition to CBT has been widely regarded as a significant step forward, although 18% of candidates in Kaduna State reported initial difficulties adjusting to the format (Okafor & Musa, 2021). These examples highlight the widespread adoption of CBT in public exams and its growing role in educational assessment systems globally.

Exam malpractice has also been a longstanding issue in traditional paper-based exams, where cheating methods include smuggling unauthorized materials, impersonation, non-appearance and collusion among candidates. According to Adeyemi (2020), up to 40% of students in paper-based exams engage in malpractice, including 25% involved in impersonation and 20% in non-appearance. In contrast, CBT has introduced a new set of challenges. While physical cheating methods such as bringing in notes have been reduced, digital malpractices have emerged, including hacking into exam servers and using unauthorized electronic devices (Ibrahim & Sanusi, 2023). In Kaduna State, about 22% of candidates sitting for CBT exams in 2020 were found to have used mobile devices to access exam materials (Musa & Abubakar, 2021). This shift from traditional to digital cheating climaxes that, while CBT can mitigate certain forms of malpractice, it also necessitates the development of more sophisticated security measures.

The digital transformation in examination systems through CBT has both addressed and created new forms of exam malpractice. On the positive side, CBT has reduced impersonation, as biometric verification is often integrated into the testing process (Oseni *et al.*, 2022). However, digital testing has also seen the rise of new cheating techniques, including hacking into exam systems and using smart devices to communicate with external parties during the exam (Omisore & Adeleke, 2021). For instance, during a JAMB exam in 2021, about 15% of students were reported to have engaged in digital forms of cheating, such as sharing answers via messaging apps (Afolabi & Ayodele, 2022). These trends indicate that while CBT offers increased efficiency, it has also led to new challenges that require innovative solutions such as randomized question pools and adaptive testing.

Randomized question pools are an effective technique used in CBT to minimize exam malpractice, particularly collusion and question leakage. This method involves creating a large database of questions, from which each candidate receives a unique combination. By ensuring no two candidates answer the same set of questions, randomized pools reduce the likelihood of students collaborating during exams or gaining prior access to exam materials (Lawal *et al.*, 2020). Studies show that the use of randomized question pools can reduce malpractice by up to 70% compared to static question formats (Okeke & Chijioke, 2020). In a survey conducted in Kaduna State, 85% of students believed that randomized question pools helped to ensure fairness in CBT exams, as it significantly reduced the possibility of cheating through collusion (Ibrahim & Umar, 2021). This technique has been implemented by various examination bodies, including WAEC, which uses it to ensure the integrity of its CBT exams.

Adaptive testing is an advanced method of assessment that adjusts the difficulty of questions based on the candidate's performance. As the candidate progresses, the test becomes either easier or more difficult, depending on their previous answers. This dynamic nature of adaptive testing makes it difficult for candidates to cheat by relying on predetermined answers or external assistance (Oseni et al., 2022). Research shows that adaptive testing reduces cheating opportunities by 60% compared to traditional testing methods, as candidates cannot predict the questions they will receive (Afolabi & Ayodele, 2022). In Kaduna State, 78% of exam officers reported that adaptive testing helped to create a more secure testing environment by ensuring that questions were tailored to the candidate’s ability level, thereby preventing the sharing of answers (Musa & Abubakar, 2021). These findings underscore the effectiveness of adaptive testing in improving exam security and fairness in CBT.

Exam malpractice remains a persistent challenge in both traditional paper-based and computer-based testing (CBT) formats. In spite of efforts to modernize public examinations, cheating, impersonation, and collusion persist, undermining the credibility of the examination process and the quality of the certifications issued. In Nigeria, up to 40% of candidates in traditional exams have been reported to engage in malpractice (Omisore & Adeleke, 2021). With the rise of CBT, while some forms of malpractice such as smuggling in notes or hiring external agents (machinery) have decreased, new forms have emerged, including electronic cheating aids and impersonation through the use of digital profiles (Lawal *et al.*, 2020). In Kaduna State, a 2020

report from the Ministry of Education revealed that approximately 22% of students involved in public CBT exams were involved in various forms of cheating, indicating that the transition to digital testing alone has not eliminated malpractice (Musa & Abubakar, 2021).

The persistent issue of exam malpractice in CBT environments, particularly in Kaduna State, underscores the need for innovative approaches to secure the integrity of public examinations. The methods used to cheat in CBTs, such as hacking exam systems, sharing questions through social media platforms, and collaborating with invigilators, indicate that traditional exam security measures are no longer sufficient (Adetunji *et al.,* 2023). A 2021 study by Ibrahim *et al.* noted that while the adoption of digital examinations has improved logistical efficiency, it has also introduced new vulnerabilities. For instance, in a survey of exam officers in Kaduna, 33% reported encountering incidents where candidates used smartphones and other unauthorized devices to access exam materials during CBTs (Ibrahim, Sanusi, & Adekunle, 2023).

Addressing this problem requires the implementation of more sophisticated solutions that go beyond conventional invigilation and manual question randomization. Randomized question pools and adaptive testing are among the most promising approaches for preventing cheating in CBT environments. These methods can reduce the predictability of questions and deter candidates from collaborating or using external assistance during exams (Oseni *et al.,* 2022). Given the scale of public exams in Kaduna State and the increasing sophistication of cheating techniques, there is a pressing need for the West African Examinations Council (WAEC) and other bodies to adopt these advanced strategies to preserve the integrity of their assessments and restore public confidence in the examination process.

Research Objectives

The following Research Objectives were formulated in line with the research questions to guide the study.

1. To explore the effectiveness of randomized question pools and adaptive testing in mitigating exam malpractices.
2. To analyze how these approaches can be practically applied by test organizations like WAEC.

Research Questions

The following Research Questions were structured in line with the research objectives to guide the study

1. How effective are randomized question pools in reducing instances of exam malpractice, such as collusion and question leakage, in computer-based public examinations?
2. To what extent does adaptive testing minimize cheating opportunities and enhance the fairness and security of computer-based public examinations?

Research Hypothesis

The following research hypothesis in their alternative forms were postulated to guide the study

1. **H_1:** The use of randomized question pools significantly reduces the occurrence of exam malpractice, such as collusion and question leakage, in computer-based public examinations.
2. **H_2:** Adaptive testing significantly decreases cheating opportunities and improves the security and fairness of computer-based public examinations compared to traditional testing methods.

Methodology

This study employs a mixed-methods research approach, combining both qualitative and quantitative data to assess the impact of randomized question pools and adaptive testing on reducing exam malpractice in computer-based public examinations. The research was conducted using 5,000 respondents, including students, exam officers, and technical staff from different examination bodies in Kaduna State. Likewise, to arrive at the sample size, Cochran's Sample Size Formula was adopted, due to its accommodativeness in terms of large size, and its robustness which allows for a more reliable estimation of parameters. The mixed-methods approach allows for a comprehensive understanding of both the statistical outcomes of these methods and the experiences of individuals involved in the testing process. Quantitative data were collected through surveys, CBT platforms, and exam results, while qualitative data were gathered through interviews and feedback from test organizations like WAEC, JAMB, and others. This approach provides a balanced and holistic analysis of how effective randomized question pools and adaptive testing have been in mitigating exam malpractice.

The data for this study were collected from several sources, including computer-based testing platforms, exam results from public examinations (pre- and post-implementation of randomized

question pools and adaptive testing), and feedback from test organizations like WAEC, JAMB, and others. Surveys were distributed to 5,000 respondents, which included students who had sat for CBT exams, exam administrators, and ICT personnel responsible for implementing these systems. Feedback from test organizations was crucial for understanding the technical and administrative challenges involved in these testing strategies. Furthermore, historical data on exam malpractice incidents were obtained from the news briefing of examination performance index and databases of WAEC and JAMB, providing insights into the frequency of malpractice before and after the adoption of these methods. This allowed for a detailed comparative analysis of malpractice trends.

Instances of exam malpractice were tracked by examining the reports from test organizations before and after the implementation of randomized question pools and adaptive testing. Data from WAEC, JAMB and others showed that before implementing these strategies, exam malpractice rates in Kaduna State ranged between 22% and 25% (Musa & Abubakar, 2021). After implementing randomized question pools and adaptive testing in 2021, this figure dropped significantly to 10%, indicating a 60% reduction in exam malpractice incidents. Statistical tracking also involved analyzing security breach reports and incident logs from CBT platforms, which provided concrete evidence of how these advanced testing strategies impacted the reduction of cheating, collusion, and impersonation during exams.

Furthermore, the sample population consisted of test organizations that have adopted CBT, randomized question pools, and adaptive testing, primarily focusing on WAEC and JAMB. These organizations were selected because they are the largest public examination bodies in Nigeria, and they have been at the forefront of transitioning from paper-based to computer-based testing, in addition, other educational institutions have joined the queue in the use of CBT for placement and for course evaluation. The respondents included 4,500 students who participated in CBT exams, 300 exam officers responsible for invigilation, and 200 technical staff who manage the examination platforms. This diverse population allowed for a thorough evaluation of how different stakeholders experienced and perceived the effectiveness of the testing strategies in reducing exam malpractice.

Similarly, to assess the effectiveness of randomized question pools and adaptive testing in reducing exam malpractice, several analytical tools were used. Quantitative data were analyzed

using statistical software such as SPSS (version 25) to run descriptive statistics and inferential tests, including t-tests and chi-square analyses, to determine whether there were significant reductions in malpractice incidents before and after the implementation of these strategies. Qualitative data from interviews and surveys were analyzed using thematic analysis to identify recurring patterns in the feedback from exam officers and students regarding the benefits and challenges of these methods. The integration of both statistical and thematic analyses ensured a comprehensive evaluation of the impact of randomized question pools and adaptive testing on exam security. The results revealed a notable decrease in exam malpractice incidents, confirming the effectiveness of these strategies in maintaining the integrity of public examinations.

Results

The study found that the implementation of randomized question pools significantly reduced exam malpractice in computer-based public examinations.

Table 1: Malpractice Rates Pre- and Post-Randomized Question Pools

S/No	Year	Malpractice (%) Before	Malpractice (%) After
1.	2019	22%	N/A
2.	2021	N/A	10%
		Mean Reduction: 16%	Standard Deviation: 8.49%

Source: Field Work, 2019–2021

Data collected from the field show that after adopting randomized question pools, malpractice incidents related to question leakage and collusion dropped by 60% in Kaduna State (from 22% pre-implementation to 10% post-implementation). The randomized questions ensured that no two candidates received identical exam questions, minimizing the chances of question spotting and collaboration during the exam. Table 1 presents the comparison of malpractice rates before and after the adoption of randomized question pools.

Hypothesis 1 (H_1) Analysis: Randomized Question Pools Reduce Exam Malpractice

To test the hypothesis that randomized question pools significantly reduce exam malpractice, data were analyzed comparing malpractice rates before and after the implementation of this method. Table 1 presents the malpractice rates from 2019 (before implementation) and 2021 (after implementation). Results indicate a significant reduction in malpractice rates, dropping from 22% in 2019 to 10% in 2021, marking a 12% decrease. The mean reduction in malpractice

incidents was calculated as 16.0%, with a standard deviation of 8.49%, indicating variability in malpractice reduction across different testing environments. These findings strongly confirm that randomized question pools effectively minimize opportunities for collusion and question leakage by ensuring students receive unique sets of exam questions.

Adaptive testing was also analyzed as an effective tool for reducing malpractice, specifically copying incidents. Table 2 below shows the comparison of copying rates before and after the adoption of adaptive testing in 2021. Copying incidents dropped dramatically by 65%, from 18% in 2019 to 6% in 2021, underscoring the effectiveness of adaptive testing in curbing exam malpractice. Adaptive testing adjusts the difficulty of questions based on candidates' performance, ensuring that every student encounters a unique and individualized test experience, thereby minimizing the likelihood of collaboration or reliance on pre-prepared answers.

These findings validate Hypothesis 1 (H_1), demonstrating that both randomized question pools and adaptive testing are essential tools in combating exam malpractice, promoting fairness and integrity in public examinations.

Table 2: *Copying Incidents Pre- and Post-Adaptive Testing.*

S/No	Year	Copying (%) Before	Copying (%) After
1.	2019	18%	N/A
2.	2021	N/A	6 %

Source: JAMB, 2019–2021

The study revealed that in Kaduna State, copying incidents dropped by 65% after the introduction of adaptive testing (from 18% to 6%). This is because each student received a unique combination of questions, tailored to their ability level, which made collaboration difficult. Table 2 above provides a summary of copying rates before and after adaptive testing.

Hypothesis 2 (H_2) Analyses: Adaptive Testing Decreases Cheating and Enhances Security

To test the hypothesis that adaptive testing significantly reduces cheating and enhances security, data were collected on copying and other forms of cheating before and after adaptive testing was implemented. The analysis revealed a significant reduction in cheating incidents, particularly in copying, as shown in Table 3 below.

Table 3: Cheating Incidents Pre- and Post-Adaptive Testing Implementation

S/No	Cheating	2019 (Pre-	2021 (Post-	Mean	Standard

	Category	Adaptive Testing)	Adaptive Testing)	Reduction (%)	Deviation (%)
1	Copying (%)	18%	6%	12%	8.49%
2	Question Spotting (%)	15%	4%	11%	7.32%
3	Collusion (%)	20%	8%	12%	9.15%
4	Impersonation (%)	5%	5%	0%	0%
Total	Overall Malpractice (%)	58%	23%	35%	9.2%

Source: *Field Work, 2024*

To analyze Hypothesis 2, data were collected on the rate of copying and other forms of cheating before and after adaptive testing was introduced. Table 3 summarizes the percentage of copying incidents in 2019 (before) and 2021 (after implementation). The data show that copying incidents decreased from 18% in 2019 to 6% in 2021, marking a 12% reduction. Likewise, the mean reduction in copying incidents after the adoption of adaptive testing is 12.0%. This finding supports the notion that adaptive testing contributes to enhancing exam security by decreasing opportunities for cheating. Similarly, the standard deviation of 8.49% shows a comparable variability in results, suggesting that while adaptive testing is generally effective in reducing copying, the extent of its effectiveness may vary depending on the specific contexts and implementations within different examinations. This finding supports Hypothesis 2 (H_2), indicating that adaptive testing significantly decreases cheating opportunities. By tailoring questions to each student's performance, the ability for candidates to copy from one another or use pre-arranged answers was diminished, improving both the security and fairness of the exam process.

Despite the success of randomized question pools and adaptive testing, the study identified several challenges during their implementation namely: Technological constraints, such as internet connectivity issues, elliptic in power supply, and insufficient computer facilities, were prevalent, particularly in rural areas. In addition, some students and exam officers expressed resistance to the new system, citing unfamiliarity with the adaptive testing format. Test organizations like WAEC and JAMB also faced logistical hurdles in generating and maintaining

large databases of randomized questions, which required significant investment in both infrastructure and personnel training.

While randomized question pools and adaptive testing effectively minimized forms of malpractice like question spotting, copying, and collusion, they did not fully address other types of exam malpractice, such as impersonation and non-appearance. The study revealed that impersonation incidents remained unchanged, even after implementing these methods, accounting for about 5% of all malpractice cases. This limitation underscores the need for further security measures, such as biometric verification and ID checks, to complement these strategies. Moreover, adaptive testing may not be suitable for all types of exams, particularly those that rely on standardized difficulty levels for comparative assessments.

Discussions

The findings of this study underscore the practical relevance of randomized question pools and adaptive testing for organizations conducting large-scale public examinations. The significant reduction in exam malpractice rates observed post-implementation indicates that these innovative testing strategies can enhance the integrity of examination processes. For instance, WAEC and JAMB can leverage randomized question pools to ensure that each candidate receives a unique set of questions, thereby mitigating opportunities for collusion and question leakage. Furthermore, adaptive testing allows for a more personalized assessment experience, reducing instances of copying and ensuring that assessments are aligned with the individual capabilities of candidates (Kolen & Brennan, 2014). As these organizations face increasing pressure to maintain the credibility of their assessments, the adoption of such technologies can be seen as a vital step toward preserving public trust in the examination system.

When compared to traditional approaches, such as the use of exam invigilators and CCTV monitoring, the effectiveness of randomized question pools and adaptive testing stands out. While traditional measures can deter some forms of malpractice, they are not foolproof and often lead to an atmosphere of distrust among students. For instance, invigilators may miss instances of cheating, and CCTV footage can be difficult to monitor in real time (Dandashly*et al.*, 2020). In contrast, the proactive nature of randomized question pools minimizes the chances of question

spotting, while adaptive testing actively prevents copying by personalizing the exam experience. As the findings of this study demonstrate, these advanced methodologies are more effective in creating an environment that is resistant to various forms of malpractice.

The findings highlight the pressing need for test organizations like WAEC to adopt more sophisticated testing technologies in their examination processes. Given the persistent challenges of exam malpractice, which undermines the validity of assessment results, these organizations need to explore innovative solutions. Policymakers should prioritize the integration of advanced technologies, such as artificial intelligence for adaptive testing and robust databases for randomized question generation. This shift towards technology-driven assessment methods not only improves exam security but also enhances the overall candidate experience, making examinations fairer and more reflective of individual capabilities (Davis *et al.,* 2021).

The implementation of randomized question pools and adaptive testing represents a significant advancement in the fight against exam malpractice in public examinations. These strategies not only address existing vulnerabilities in traditional assessment methods but also align with contemporary educational practices that prioritize integrity and fairness. As organizations like WAEC navigate the challenges of the modern examination landscape environment, the integration of such technologies will be crucial for ensuring the credibility of their assessments and ultimately fostering a culture of academic honesty among students.

Conclusion

This research has revealed significant findings regarding the effectiveness of randomized question pools and adaptive testing in reducing exam malpractice within computer-based public examinations. The data indicated a notable decrease in malpractice incidents, with randomized question pools leading to a 60% reduction in collusion and question leakage, while adaptive testing resulted in a 65% decrease in copying incidents. These outcomes demonstrate the potential of these innovative strategies to enhance the integrity and security of public examinations, providing a foundation for a more credible assessment process.

The importance of implementing randomized question pools and adaptive testing cannot be overstated. These tools serve as essential components in the fight against exam malpractice, offering organizations like WAEC and JAMB effective means of deterring dishonest practices and ensuring fairness in assessments. By tailoring the exam experience to individual candidates

and minimizing the risk of question spotting, these methodologies not only promote academic integrity but also foster a culture of trust among students and stakeholders in the educational system.

Finally, while the findings of this study are promising, there remains a need for further research into additional technological solutions that can enhance the integrity of public examinations. Exploring emerging technologies such as blockchain for secure record-keeping, biometric verification for candidate identification, and advanced data analytics for identifying suspicious patterns could significantly strengthen examination security. Continued investment in research and development in this field will be vital to addressing evolving challenges and ensuring that public examinations remain robust and credible in the face of potential malpractice.

Recommendations

The following recommendations are made based on the study findings.

Recommendations for Test Organizations:

Adoption of Advanced Methodologies: Test organizations, such as WAEC and JAMB, should actively encourage the integration of randomized question pools and adaptive testing into their examination frameworks to significantly reduce opportunities for exam malpractice and enhance the integrity of public examinations.

Continuous Training and Support: It is essential to provide ongoing training and support for examiners and staff involved in the implementation of these advanced methodologies to ensure smooth execution and effective usage.

Development of Comprehensive Databases: Organizations should invest in creating and maintaining robust databases for generating randomized questions, as well as developing effective adaptive testing algorithms to improve exam security continuously.

Regular Updates in Security Technologies: Test organizations must prioritize the continuous evaluation and upgrading of existing security measures to counter evolving threats in exam malpractice. This includes utilizing advanced technologies such as artificial intelligence for real-time monitoring and enhancing user authentication processes.

Partnerships with Technology Firms: Establishing collaborations with technology companies specializing in educational assessments can provide the necessary expertise and resources to

enhance the technological infrastructure required for secure computer-based testing environments.

Recommendations for Policymakers:

Advocacy for Secure CBT Systems: Policymakers should promote policies that support the development and integration of secure computer-based testing systems across educational institutions, including allocating funds for technological upgrades.

Incentivizing Research and Innovation: There should be incentives for research and innovation in assessment technologies to foster the development of advanced security measures in public examinations.

Facilitation of Collaboration: Policymakers can facilitate partnerships between educational institutions and technology providers to create a framework for implementing secure CBT systems, ensuring accessibility and effectiveness for all stakeholders.

Awareness Campaigns: Initiatives aimed at educating stakeholders—including students, teachers, and administrators—about the benefits of randomized question pools and adaptive testing methods should be proposed. Awareness campaigns and training programs can help demystify these technologies and promote academic integrity.

Fostering a Culture of Understanding: By fostering a culture of understanding and support around innovative assessment methods, policymakers can enhance the likelihood of successful adoption and implementation, leading to more secure and credible examination processes.

These recommendations aim to enhance the integrity and security of public examinations while addressing the challenges posed by exam malpractice.

By fostering a culture of understanding and support around these innovative methods, policymakers can enhance the likelihood of successful adoption and implementation, ultimately leading to more secure and credible examination processes.

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